5.0 DOCUMENTATION ASSESSMENT

This portion of ASP I provides an assessment of the completeness of available model documentation and the compliance of each component to a set of proposed, tailored standards; recommendations for bringing the documentation into compliance with those standards; and implications of the current state of documentation on model use and V&V efforts. This assessment provides the model manager with specific information on how the documents can be improved and also provides the model user with a quick description of the adequacy of the documentation set.

The standards against which the documentation were assessed were derived from a study sponsored by SMART and documented in a report entitled *Software Verification Requirements Study for the SMART Project*. [9]. The SVRS describes the minimum set of documents and content standards required to assist a potential user to evaluate the suitability of an existing model for a specific purpose and ensure that it has been rigorously verified against known standards and procedures. These documents should allow the potential user to: have confidence that the model is accurate; decide if the model simulates the problem(s) of concern; have sufficient information to install and run the program(s); modify the model to work on the target platform (if necessary); understand all inputs and outputs; and fix problems during model use, either due to runtime errors, incorrect input, or incorrect program operation.

The starting point for formulating these recommendations was DOD-STD-2167A, Defense System Software Development, which established requirements to be met by government contractors for the acquisition, development, or support of software systems. This document grew out of the need to standardize and manage the development of computer software in the DoD community and it includes requirements for software documentation. After an extensive search for, and review of, government requirements and guidelines, the following documents were identified as the minimum set necessary for mature model verification: Software Design Document (SDD), Software User's Manual (SUM), Software Analyst's Manual (SAM), Software Programmer's Manual (SPM), and Software Verification Report (SVR).

The SUM and SPM formats described in DOD-STD-2167A were tailored for digital simulation models. The SAM is not addressed by 2167A and its format was generated after a review of other sources. Electronic Combat Digital Evaluation System (ECDES) Model Documentation and Programming Guidelines were also used as guidelines for implementing DOD-STD-2167A. The existing SAMs for ESAMS, ALARM, and RADGUNS were also used to provide guidance for the recommendations. The SDD and SVR typically do not exist for mature models. However, SMART has sponsored tasks to support the development of equivalent documents for several models: the Post-Development Design Document (PDDD) and Verification Reports (VRs).

EADSIM documentation consists of a set of five documents packaged into six separate manuals. These are the Executive Summary (ES), the Software User's Manual (SUM), the User's Reference Manual (URM), Parts I and II, the Methodology Manual (MM), and the Manual Set Addendum (MSA). The first four of these documents are for EADSIM Version 4.0 and the last one describes changes incorporated into Version 4.01[1]. However, to date,

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1. The documentation assessment reported here applies to Version 4.01. a new documentation set has been released with Version 5.0.

no complete manuals exist solely for Version 4.01, since Version 4.0 documents generally apply to Version 4.01. The ES wasn't included in the supplied documentation set, although it is referenced in the MM. Some of the information in the ES should be included in the SPM. The URM has been divided into two separate volumes due to its large size. Table 5-1 summarizes the assessment of existing EADSIM documentation. Note that a SPM, PDDD, and VR have not been published to date.

TABLE 5-1. Documentation Assessment Summary for EADSIM.

Characteristic	SUM	SPM	SAM
Publication Date	16 May 1994	N/A	16 May 1994
Applicability	EADSIM 4.01	EADSIM 4.01	EADSIM 4.01
Completeness	Adequate (Complete except for assumptions and limitations, error messages, and input/output variable descriptions)	Non-existent (Will have to be developed from scratch except for information on the programming environment, input variables, and troubleshooting)	Adequate (Complete except for assumptions and limitations; correlation of inputs, outputs, and modules to functional elements; and an overall methodology description)
Compliance	Does Not Comply	Does Not Comply	Does Not Comply
Note: The characteristics and adequacy of the model documentation summarized in the above table are defined as follows: * Completeness The completeness of the documentation is stated as "Complete," "Adequate," (the implication being incomplete, but adequate), "Inadequate," or "Non-existent." * Compliance The compliance of the documentation with referenced standards is stated as "Complies" or "Does Not Comply." * Applicability The version of the model the documentation represents is stated as "Current" (the latest version) or "Version (n.n.n)."				

5.1   COMPLETENESS

Tables 5-2 through 5-4 provide summaries of the completeness of the SUM, SPM, and SAM detailed by elements required for each section. Summing the results out of a total of 43 content elements, 16 were included and complete, 15 were included but partially complete, and 12 were not included.

5.1.1   Completeness of Software User's Manual

The EADSIM SUM [2] is close to providing all information required. Most of the information of the proposed SUM can be copied from the existing EADSIM 4.0 SUM. Only the format in which it is presented need be modified. The only serious deficiencies are the lack of an adequate list of error messages and the discussion of assumptions and limitations. Also, sections for a document overview and for referenced documents should be developed. The document overview should be similar to that in the Introduction Section of the MM [4]. Table 5-2 summarizes the contents of the EADSIM SUM.

TABLE 5-2. Contents Summary of SUM for EADSIM.

Software User's Manual	Complete
Title Page and Preliminary Information	P
1.1 Identification	Y
1.2 System Overview	P
1.3 Document Overview	P
2.0 Referenced Documents	N
3.1 Initialization	Y
3.2 User Inputs	P
3.3 Links to Other Programs	Y
3.4 Outputs	Y
4.0 Error Messages	P-SUM, MM
5.0 Terms and Abbreviations	Y-MM
Appendix A: Assumptions and Limitations	N

Notes:	
Y	Included and Complete
N	Not Included
P	Partial Treatment
Y-XXX	Complete Treatment in Another Manual
SUM	Software User's Manual
MM	Methodology Manual

5.1.2   Completeness of Software Programmer's Manual

No SPM was provided with the Documentation Set. Most of the material required by a standard SPM is missing from the document set and will have to be developed from scratch. However, some of the information normally contained in this manual can be found in the other manuals. Table 5-3 shows completeness for each standard SPM section.

TABLE 5-3. Contents Summary of SPM for EADSIM.

Software Programmer's Manual	Complete
Title Page and Preliminary Information	N
1.1 Identification	Y-MM
1.2 System Overview	P-MM
1.3 Document Overview	P-MM
2.0 Referenced Documents	N
3.1 Equipment Configuration	Y-SUM, RN, ES
3.2 Operational Information	Y-SUM, ES
3.3 Compiling and Linking Instructions	Y-RN, SUM, URM
4.1 Introduction to Programming Information	N
4.2 Call Hierarchy	N
4.3 Dictionary of Variables	P-URM

TABLE 5-3. Contents Summary of SPM for EADSIM. (Contd.)

Software Programmer's Manual	Complete
4.4 Global Variable	N
4.5 Program, Subroutine and Function Descriptions	N
4.6 Error Detection and Diagnostic Features	P-SUM, MM
5.0 Terms and Abbreviations	Y-MM
Appendix A: Detailed Call Hierarchy	N

Notes:
 	
  Y-XXX   Complete Treatment in   SUM   Software User's Manual
              Another Manual   RN   Release Notes, V4.01
  N   Not Included   ES   Executive Summary
  P   Partial Treatment   MM   Methodology Manual
  P-XXX   Partial Treatment in   URM   Users Reference Manual, Part II
              Another Manual	

5.1.3   Completeness of Software Analyst's Manual

The information required for the SAM for EADSIM Version 4.0 is primarily contained in a document called the MM [4]. It is close to fulfilling all the requirements for a standard SAM; however, several topics were either not discussed at all, discussed inadequately, or scattered among different sections and not grouped together. The most significant omissions were those regarding discussions of referenced documents, assumptions and limitations, inputs and outputs to areas of functionality, and module correlation with functionality. Discussions about the overall methodology or on justifications for probability distributions were also omitted.

Section 3.3 of the EADSIM SAM should be subdivided into areas of functionality that represent individual subsystems or subfunctions of the overall model. These areas, called Functional Elements (FEs), are being identified in a task sponsored by the SMART Project. A subsection for each FE should be developed and included in standard SAM, Section 3.3. The similarity of model functions can be utilized to produce similar SAM functional descriptions for easy cross-referencing between documents written for different computer models. Table 5-4 shows the completeness for each SAM section.

TABLE 5-4. Contents Summary of SAM for EADSIM.

Software Analyst's Manual	Complete
Title Page and Preliminary Information	P
1.1 Identification	Y
1.2 System Overview	P-SUM
1.3 Document Overview	Y
2.0 Referenced Documents	P
3.1 Functional Description Overview	Y
3.2.1 Assumptions and Limitations	P

TABLE 5-4. Contents Summary of SAM for EADSIM. (Contd.)

Software Analyst's Manual	Complete
3.2.2 Overall Modeling Methodology	N
3.3 Detailed Functional Implementation Methodology	
a. Equations and Algorithms	P
b. Equations for Variables	Y
c. Inputs and Outputs	P
d. Module Correlation with Functionality	N
e. Impact on Model Results	Y
4.0 Terms and Abbreviations	Y
Appendix A: Detailed Assumptions and Limitations	N
Notes:	
Y Included and Complete	
N Not Included	
P Partial Treatment	
P-XXX Partial Treatment in Another Manual	
N/A Not Applicable	
SUM Software User's Manual	

5.2   COMPLIANCE WITH DOCUMENTATION STANDARDS

This section presents detailed documentation standards and documentation compliance discussions to accomplish these standards for EADSIM. Information related to the SUM, SPM, and SAM was assessed for compliance using the standards described in the following sections. Details of this assessment are presented below.

5.2.1   Software User's Manual

The purpose of the SUM is to provide information and instructions enabling the user to execute a model. It should describe the execution steps, the expected output, and necessary actions when error messages appear. The SUM also provides an introduction to the model. The SUM facilitates the capability to operate the model correctly and to obtain the background for a deeper understanding of the model. The model should be described at a high-level using summarized theoretical information.

5.2.1.1   Standards

The format and contents for a SUM are described in [9] and repeated below:

Title Page and Preliminary Information. A SUM Title Page should include the following information: Model Name, Version Number, Volume Number (if applicable), Development Agency, Contract and CDRL numbers (if applicable), Date Published, Distribution, Destruction Notices (if applicable), and Document Control Number (DCN). The Contractor Name and Address should also be included on the Title Page, prefaced by the term "Prepared by." In addition to the Title Page, a Foreword (Abstract), Table of Contents, List of Tables, and List of Figures should be provided as well.

SECTION 1: INTRODUCTION

1.1   Identification. Identify the exact model title, its acronym or abbreviation, the version number, and any other official model identification information.

1.2   System Overview. State the purpose of the model. Include its mission, a general description of the physical systems simulated, and a general description of the intended scenarios. Provide overviews of all major modes of operation and scenarios corresponding to each mode. Auxiliary programs used to generate input data or process output data should be acknowledged and such auxiliary software should be detailed in Section 3.3 (entitled "Links to Other Programs").

1.3   Document Overview. List and describe the purpose of each section of the SUM. Also identify any other documents in the Document Set containing the SUM.

SECTION 2: REFERENCED DOCUMENTS

List the title, number, author, publisher, date and classification level (unless all are unclassified) for each document used in generating the SUM, and for all known documentation for this model. Include sources for all documents not available through normal government stocking activities.

SECTION 3: EXECUTION PROCEDURES

Present detailed procedures necessary to run the model. The instruction set should be comprehensible by a user unfamiliar with the software design. Each subsection in this section should describe step-by-step instructions for executing the model including details of the options available to the user at each step.

3.1   Initialization. Describe the initialization procedures necessary to execute the model. Detail all initialization options.

3.2   User Inputs. Describe user inputs at the file or data set level. Include variable name, format, allowable ranges, units of measure, and definition of each input item.

3.3   Links to Other Programs. Detail model relationships with pre- and post-processors. Describe drivers not considered part of the model, but part of the delivered model package. Discuss any other program with a link to this model.

3.4   Outputs. Detail the expected outputs from the model. This includes narrative reports as well as files. When applicable, give filenames with paths, data format and units of measure.

SECTION 4: ERROR MESSAGES

List each possible error message with a detailed explanation of each message. Provide a definitive course of action for each error message including instructions for restarting the model.

SECTION 5: NOTES

5.1   Glossary of Terms.

5.2   Abbreviations.

APPENDICES. Appendices may be used for ease in document maintenance or for readability of the core text material. Examples of appendix contents are graphs, sample user interface printouts, and any classified information.

APPENDIX A: DETAILED ASSUMPTIONS AND LIMITATIONS

Appendix A is reserved for describing all model assumptions and limitations. These should be organized by major areas of functionality.

5.2.1.2   Assessment

The EADSIM Version 4.0 SUM is very close to providing all information required by the SUM standards. The assessment of the EADSIM SUM is detailed in the paragraphs which follow. Based on the assessment, specific recommendations are provided to satisfy the SUM requirements.

Title Page and Preliminary Information. The Table of Contents and List of Illustrations in the current SUM comply with the requirements of the standard SUM. However, the Title Page for the current SUM is lacking information pertaining to the Contractor Name and Address, Contract and CDRL Numbers (if applicable), Distribution and Destruction Notices (if applicable), and a Document Control Number (DCN). The page after the Title Page contains the Contractor Name and Address along with some information redundant with the Title Page. This information should be moved to the Title Page and this page then deleted. In addition, no Foreword exists for the SUM; therefore, one should be developed for inclusion in the standard SUM. Since there are no tables in the current SUM, the requirement for a List of Tables may be omitted.

1.0   INTRODUCTION.

1.1 Identification. The SUM includes EADSIM identification information with the introduction in Section 1.0. The information on the EADSIM Document Set in the last two paragraphs of this section needs to be moved to the document overview discussion in standard SUM, Section 2.0. The rest of the information in this discussion should be included in standard SUM, Section 1.1.

1.2 System Overview. Section 2.0 of the current SUM includes a good top-level functional overview of the general areas modeled by the software. These overviews should be included in the standard SUM, Section 1.2. A high-level discussion of the off-line post-processing tools described in current SUM, Section 7.3 and in URM, Part II, Section 8.0 should be developed for standard SUM, Section 1.2.

1.3 Document Overview. A document overview listing the purpose of each SUM section should be developed and included in SUM, Section 1.3.

2.0   REFERENCED DOCUMENTS.

No references to other documents exists in the current SUM. A list of referenced documents needs to be developed for standard SUM, Section 2.0. In addition, the information on the EADSIM Document Set in the last two paragraphs of current SUM, Section 1.0 needs to be moved to this section. The ES needs to be mentioned as part of the Document Set, similar to that in the Introduction in current MM, Section 1.0. In addition to the standard SUM, SPM, and SAM, any other documents released concurrently with these documents should also be mentioned in this section.

3.0   EXECUTION PROCEDURES.

3.1 Initialization. Initialization procedures and options are covered in Sections 4.1, 4.2, 4.3, and 6.1 of the current SUM. However, Section 4.1.7 should be detached

from Section 4.1 and included in standard SPM, Section 3.3. These sections explain how to run EADSIM along with some of its basic operating procedures. Section 4.1 covers some basic run procedures, while Sections 4.2 and 4.3 cover various Windows options. Section 6.1 covers the initial setup as well as program execution in both the Windows and UNIX environments. Note that the Windows option refers to UNIX-based utilities found on SGI and SUN workstations and not the operating system for IBM-compatible PCS. In addition to these current SUM sections, Tab C of the URM, Part II describes run procedures using two UNIX shell scripts. The information in all of these sections (except current SUM, Section 4.1.7) should be included in standard SUM, Section 3.1.

3.2   User Inputs. The bulk of the existing SUM is devoted to the Scenario Preparation Guide in Section 5.0. This section includes instructions on defining, editing, and displaying scenario generation input files. It also has instructions for running various utility functions. Also included for map generation purposes are directions for extracting select information from the Defense Mapping Agency (DMA) database containing either ARC Digitized Raster Graphic (ADRG) or color-coded Digitized Terrain Elevation Data (DTED) Map images. This information should be included in the standard SUM, Section 3.2. Details of both the content (variable names and descriptions) and the format of input files are contained in Tab D of the URM, Part II. Most of the input file variables are not described in this section. Only the Display Preference variables in Section D.8 of Tab D have adequate descriptions. The remaining variables generally only have format and unit of measure information and have no descriptions. However, in most cases the main body of the URM, which details the options available for each program window, describes options that correspond to these input file variables. These descriptions are interspersed with those for other Windows options and the option names do not necessarily match the variable names contained in the input files. The user would have to hunt throughout the body of the URM to find an option description that corresponds to one of these input file variables in Tab D. Variable descriptions should be added to Tab D of the URM and should be included in standard SUM, Section 3.2. Sections 3.0 and 7.0 of the URM detail Window options available for user input. Since a high-level discussion of the topics covered in these sections already exists in Section 5.0 of the current SUM, the Window options should remain in the URM. The sectional format of the URM should remain intact except for Section 8.0 and the Tabs, which should be moved to other sections or appendices. However, instead of calling this document the URM, Parts I and II it should be renamed to be Appendix B, Volumes I and II of the standard SUM. Use of an appendix is necessary due to the size of the sections covering these topics.

3.3 Links To Other Programs. EADSIM Version 4.01 can interface with other simulation models via three options in the External Connections Window. Two of these options are the Aggregate Level Simulation Protocol (ALSP) and the Distributed Interactive Simulation (DIS) communication protocols. The third option is for the BRAWLER simulation model which is accessed from the DIS protocol. These interfaces are described in detail in SUM, Section 8.0 of the MSA for EADSIM Version 4.01, but are not included with Version 4.0. In addition, four post-processing tools used for the generation of statistical data are discussed in Section 7.3 of the current SUM. Data pertaining to Airbase Statistics, Intelligence Center Statistics, Formatted Scenario (FORMSCEN) and Scenario Playback is generated by these

tools. The first two statistical tools can only be accessed off-line. FORMSCEN can be accessed either by EADSIM or off-line, and the Scenario Playback routine can only be accessed by EADSIM. The information in both of these sections should be included in standard SUM, Section 3.3.

Section 8.0 of the URM, Part II details non-graphical off-line tools available to the user. Since identical discussions on most of the tools already exist in Section 7.3 of the current SUM, they are redundant and should be deleted. However, the Trajectory Analyzer, Non-Graphical Post Processor, and Trajectory Extractor off-line tools are not mentioned in the discussion in current SUM, Section 7.3. The sections containing the discussions on these tools (URM, Sections 8.4, 8.5, and 8.6) should be included in standard SUM Section 3.3 with the information from Section 7.3 of the current SUM. In addition, the FORMSCEN discussion in URM, Section 8.3 covers the non-graphical version of this tool while that in current SUM, Section 7.3.3 covers FORMSCEN as a menu item in EADSIM. These sections need to be included as separate subsections in a section on FORMSCEN for inclusion in standard SUM, Section 3.3. The discussion on Intelligence Center Statistics in URM, Section 8.2 contains fourteen statistics descriptions while that in current SUM, Section 7.3.2 contains only eight. The additional six statistics from the URM (statistics 9 through 14) need to be added to current SUM, Section 7.3.2 for inclusion to standard SUM, Section 3.3. All of URM, Section 8.1 and the remaining information in Section 8.2 is redundant information and should be deleted.

3.4 Outputs. These are described in current SUM Sections 6.2, 6.3.2, 7.1, and 7.2 regarding Model Operations, Log File (.c3ilog) Descriptions, the Overview of Model Output Files (Post-Processing), and the Post-Processing Operational Instructions, respectively. These descriptions should be included in standard SUM, Section 3.4. Detailed descriptions of the Scenario Playback, Post Processing, and FORMSCEN output options are discussed in URM, Sections 4.0, 5.0, and 6.0, respectively. The sections detail Window options related to program outputs. Since a high-level discussion of outputs is already in Section 7.0 of the current SUM, detailed descriptions should be left in the URM which should be renamed as Appendix B of the standard SUM. Use of an appendix is recommended due to the size of the sections detailing these outputs.

4.0   ERROR MESSAGES.

Explanations are given about how to troubleshoot error messages; however, none are actually described. A list of error messages is not included in the current documentation. Error message troubleshooting options are discussed in Sections 6.3.1 and 6.3.3 of the SUM. In addition, Section 6.3.4 describes run-time crashes (rename as "Fatal Execution Errors") but doesn't discuss any of the error messages that accompany such events. The documentation needs to list and describe all possible error messages with subsequent corrective actions. This should be included in SUM, Section 4.0. Nevertheless, good descriptions in Section 6.3.2 of messages in the log output files could be useful for debugging a scenario. Applicable error messages from these output files should be included in SUM, Section 4.0. Since most of these messages aren't specifically for errors, they should be included in the discussion of outputs in the SUM, Section 3.4. The description of an error checking utility from the Scenario Generation application is provided in Section 8.6 of the MM.

This includes a table listing the error message, its category, and any resultant action or default. This information should also be included in Section 4.0 of the standard SUM.

5.0   TERMS AND ABBREVIATIONS.

Definition of Terms and Abbreviations and Terms is in the MM. Such definitions applicable to the SUM should be included in standard SUM, Section 5.0 along with the addition of definitions for terms and abbreviations unique to the SUM.

APPENDIX A: DETAILED ASSUMPTIONS AND LIMITATIONS.

Model assumptions and limitations are not in any of the manuals. These should be developed in detail for each major area of functionality and included in standard SUM, Appendix A.

Other Appendices. Current SUM, Section 3.0 contains detailed descriptions of each option in the software package. It has been divided into two separate URMs due to its size. The URM should remain in separate manuals and should be renamed to be Appendix B, Volumes I and II of the standard SUM (except for Section 8.0 and the Tabs). Six Tabs at the end of the URM, Part II are, in essence, appendices to the URM. Tabs C and D should be moved to standard SUM, Sections 3.1 and 3.2, respectively. Tabs E and F should be moved to standard SUM, Appendices C and D, respectively. The remaining Tabs should be moved either to sections or appendices of the standard SPM as discussed in the assessment of that document. The UNIX Quick Reference found in Section 4.5 of the current SUM should be moved to Appendix E of the standard SUM.

5.2.2   Software Programmer's Manual

The purpose of the SPM is to enable a user or programmer to understand the operation of a model; install, maintain, and modify it; and convert it for use on other computer systems. The SPM addresses the software implementation of the model rather than theoretical considerations. It provides a guide to the internal workings of the software. It includes information on compiling and linking the code as well as descriptions of hardware and software requirements and peculiarities. If hardware or software listed in an SPM is commercially available, its existing documentation should be referenced by document title and number, and the manufacturer should be cited.

5.2.2.1   Standards

The recommended format for a SPM is described in [9] and repeated below:

Title Page and Preliminary Information. The SPM Title Page should include the following information: Model Name, Version Number, Volume Number (if applicable), Development Agency, Contract and CDRL Numbers (if applicable), Date Published, Distribution and Destruction notices (if applicable), and Document Control Number (DCN). The contractor name and address should also be included on the Title Page, prefaced by the term "Prepared by." In addition to the Title Page, a Foreword (Abstract), Table of Contents, List of Tables, and List of Figures should also be provided.

SECTION 1: INTRODUCTION

1.1   Identification. Identify the exact model title, its acronym or abbreviation, the version number, and any other official model identification information.

1.2   System Overview. State the purpose of the model. Include its mission, a general description of the physical systems simulated, and a general description of the intended scenarios. Provide overviews of all major modes of operation and scenarios corresponding to each mode. Auxiliary programs used to generate input data or process output data should be acknowledged and described.

1.3   Document Overview. List and describe the purpose of each section of the SPM. Also identify any other documents in the document set containing the SPM.

SECTION 2: REFERENCED DOCUMENTS

List the title, number, author, publisher, date, and classification level (unless all are unclassified) or each document used in generating the SPM and for all known documentation for this model. Include sources for all documents not available through normal government stocking activities.

SECTION 3: PROGRAMMING ENVIRONMENT

3.1   Equipment Configuration. Describe the computing devices and operating systems that the model operates on and under (developmental and target environment). List other software required for model execution. An example of a software requirement is a graphical user interface (GUI).

3.2   Operational Information. Describe hardware/operating system characteristics and capabilities required for the model. This includes details such as storage space for the source code with a complete input set, memory requirements with utilization examples, memory protection features and input/output (I/O) characteristics.

3.3   Compiling and Linking Instructions. Present instructions on compiling and linking the model software and describe equipment needed for such procedures. Detail applicable names and version numbers of equipment or software.

SECTION 4: PROGRAMMING INFORMATION

4.1   Introduction. Describe in general the applicable programming conventions and style used to develop the model. A short development history emphasizing programming style and convention evolution could be helpful for mature models with a diverse history.

4.2   Call Hierarchy. Present a top-level subroutine (function) call tree. It should branch down only as far as the main routines for each major area of functionality. A comprehensive call hierarchy (probably generated by an automated software tool) should be included in Appendix A.

4.3   Dictionary of Variables. List all variables alphabetically and provide a definition of each (with units of measure). State whether each variable is global or local. If global, give the name of the common block containing it. If local, list the module(s) containing it.

4.4   Global Variables. Global variables are contained in common blocks for programs written in FORTRAN and are called external variables for programs written in C. Other programming languages will have their own conventions for the handling of global variables. Using the convention appropriate to the programming language, list these variables alphabetically. For example, the common blocks from FORTRAN programs should be listed alphabetically. For each block, list the variables contained in it, give a general description of these variables, and list the modules in which it appears. For programs written in other

languages, just list the variables alphabetically, give a general description of these variables, and list the modules in which they appear.

4.5   Program, Subroutine, and Function Descriptions. Provide detailed information about each program, subroutine, or function (hereafter called "module"). List modules alphabetically. Library functions should be listed but only briefly described. All other module descriptions should contain the following information in a clear, concise format useful to a programmer tasked with maintaining the model.

    a.   Give a brief narrative description of the module, its objective, and method for fulfilling the objective should be stated.

    b.   Give its location in a specified file, its call sequence, security classification level, and size (number of lines of executable code).

    c.   Provide a list of calls made by the module and calls to the module.

    d.   Alphabetically list all variables used by the module. For each variable, list its dimension, type, usage as input and/or output, engineering units, a very brief description, and its usage as an argument, local, or common variable. The user can refer to the Dictionary of Variables (Section 4.3) for a detailed description.

    e.   Detailed Description. Elaborate on the objectives and methods used to fulfill the objectives stated in the brief description in list item "a" above. Provide a reference in the SAM if a theoretical discussion related to the modeled processes is provided.

4.6   Error Detection and Diagnostic Features. Describe model error diagnostics. Provide a table listing each error condition, the routine(s) in which it is utilized, the model variable(s) involved, and the conditions (logic) causing the error. (These diagnostics also are summarized in the SUM, Section 4).

SECTION 5: NOTES

5.1   Glossary of Terms

5.2   Abbreviations

Appendices. Appendices may be used for ease in document maintenance or for readability of the core text material. Examples of appendix contents are subroutine call tree, flow diagrams, sample user interface printouts and any classified information.

APPENDIX A: DETAILED CALL HIERARCHY

Present the complete calling hierarchy in this appendix.

5.2.2.2   Assessment

EADSIM Version 4.01 does not have a SPM. However, the SUM and MM contain some of the requirements for a SPM. The following paragraphs contain specific recommendations for satisfaction of the SPM requirements listed in Table 5-3.

Title Page and Preliminary Information. Since this document does not yet exist, none of the required information for this section has been generated. A Title Page, Foreword, Table of Contents, and Lists of Figures and Tables should be developed for the standard SPM. The Title Page should contain all the information required by the SPM standards. Information for the remaining items should be generated as needed.

1.0   INTRODUCTION

1.1   Identification.   The Introduction from Section 1.0 of the MM contains EADSIM identification information in the first paragraph which should be included in standard SPM, Section 1.1. The last two paragraphs are overviews of the document and the Document Set and should not be included in this section.

1.2   System Overview. The overview in Section 2.0 of the MM should be included in standard SPM, Section 1.2. A high-level discussion of the off-line post-processing tools described in current SUM, Section 7.3 and in URM, Part II Section 8.0 should be developed for standard SPM, Section 1.2.

1.3   Document Overview. A document overview similar to that in the third (last) paragraph of Section 1.0 of the MM needs to be developed for inclusion to standard SPM, Section 1.3.

2.0   REFERENCED DOCUMENTS.

A list of referenced documents should be developed for standard SPM, Section 2.0. The reference to the EADSIM documentation set in the second paragraph of Section 1.0 of the MM should also be included in this section.

3.0   PROGRAMMING ENVIRONMENT.

3.1   Equipment Configuration.   The equipment configuration for SUN SPARCstations is covered in Section 4.4.1 of the current SUM. Additional requirements for SUN SPARC-stations are also discussed in Section 4.2 of the Release Notes (RN) contained in the MSA. In addition, Section 4.1 of the current SUM is devoted to startup and use of the software on a Silicon Graphics IRIX 4-D workstation. UNIX Window Control and Token Operations are described in current SUM, Sections 4.2 and 4.3, respectively, for SGI machines. Specific hardware and software (operating system) requirements for SGI machines are discussed in Section 1.4 of the EADSIM ES [1] as well as in Sections 4.0, 4.1, and 5.0 of the RN contained in the MSA. The SGI systems requirements need to be consolidated along with those for the SUN systems and be included in Section 3.1 of the standard SPM. Redundant and/or obsolete information from these sections should be eliminated from this discussion.

3.2   Operational Information. The only discussion of disk storage requirements was found in Section 1.4 of the EADSIM ES. In addition, enhancements available through the use of the Solaris 2.3 Operating System with the recommended hardware are discussed in Section 2.8 of the RN in the MSA. Section 4.4.2 of the current SUM discusses functionality topics such as limitations of graphics capabilities using the Solaris 2 operating system on SUN SPARCstations. SUM, Sections 4.4.3 and 4.4.4 discuss issues relating to both hardware and software operating characteristics of the system. All of these sections need to be included in standard SPM Section 3.2.

3.3   Compiling and Linking Instructions. No compilation instructions are described in any of the supplied manuals, but they are not required since executable files are provided with the release tape for EADSIM Version 4.01. However, instructions for linking the software are provided in discussions about installation on SGI and SUN machines in Section 4.0 of the RN portion of the MSA. A discussion about loading the software onto a SGI series 4D workstation is detailed in Section 4.1.7 of the current SUM.   Finally, information about setting up

environmental variables is contained in Tab B of the URM, Part II. Software installation and linking discussions as well as environmental setup discussions from these sections need to be included in standard SPM Section 3.3.

No requirements for any additional compiling/linking equipment are currently cited. A discussion about "tool chest" setup on SGI workstations is contained in Section 5.0 of the RN in the MSA. This section discusses how to set up SGI "tool chest" utilities under the IRIX 4.0 Operating System in order to run EADSIM. This discussion should be included in standard SPM, Section 3.3.

4.0   PROGRAMMING INFORMATION.

4.1   Introduction. A discussion on programming conventions and styles should be developed for standard SPM, Section 4.1. A short developmental history emphasizing programming style and convention evolution should be described in this section as well.

4.2   Call Hierarchy. This is not given in any of the existing manuals. A high-level call tree should be added to standard SPM, Section 4.2 and a complete call tree should be put in Appendix A of the SPM.

4.3   Dictionary of Variables. Input file variables are described in the discussion on file formats in Tab D of the URM, Part II. While these variables probably correlate to those contained in the source code, a complete alphabetical list of all variables in EADSIM needs to be developed, including definitions and units of measure. This information should be included in standard SPM, Section 4.3.

4.4   Global Variables. A discussion of global variables is not included in any of the existing manuals. For programs written in C language, such as EADSIM, global variables are defined as external variables. This section should define all external variables, what routines they are used in, and how to make variable changes. It should be added to standard SPM, Section 4.4.

4.5   Program, Subroutine, and Function Descriptions. Module descriptions are not provided in any of the existing manuals. For programs written in C language, such as EADSIM, functions are used in place of subroutines. The recommendation is to include function descriptions using the format described in the SPM standards (Section 5.2.2.1) and in Figure 5-1. This information should be added to Section 4.5 of the standard SPM.

4.6   Error Detection and Diagnostic Features. High-level error message categories are described in the current SUM. However, error messages are neither listed nor described in detail. Nonspecific solutions are provided for most error messages, with the diagnosis of run-time crashes being portrayed as beyond the capabilities of the average user. Run-time messages contained in log output files can sometimes be useful in troubleshooting efforts. These messages are described in the SUM and are not necessarily error messages. Detailed descriptions of errors with specific corrective actions should be included in Section 4.6 of the standard SPM. The description of an error checking utility from the Scenario Generation application is provided in Section 8.6 of the MM. This includes a table listing the error message, it's category, and any resultant action or default. This information should also be included in Section 4.6 of the standard SPM.

FUNCTION NAME: AddHeight

1. Brief Description: This function will add a scalar height to a vector.

2. Calling Sequence: AddHeight (&OpFac -> Position, (double) ComSub -> AntHeight, &ComSub -> Antenna);

3. Security Classification: Unclassified

4. Program Size: 40 lines (21 executable lines)

5. Location: File ANTENNA.C, Line 662

6. Calling Environment

   Calls: none
   Called By: SetAntenna

7. External Variables: UnitVector(Position, NewPosition)

8. Internal Variables:

Name	Usage	Dim	I/O	Type	Definition	Units
Position	loc	1	I	Vector	current antenna position	m
Height	loc	1	I	Scalar (real-double precision)	scalar height to add to the antenna position	m
NewPosition	loc	1	O	Vector	new antenna position	m
X	arg	1	---	Real	X component	m
Y	arg	1	---	Real	Y component	m
Z	arg	1	---	Real	Z component	m

9. Discussion and Formulation:

The current position vector of the antenna is stored in Position, while the new position vector of the antenna is in NewPosition. The X, Y, and Z components of the new antenna position are calculated as follows:

$$X_{NEW} = (X_{NEW} \times HEIGHT) + X_{OLD}$$

$$Y_{NEW} = (Y_{NEW} \times HEIGHT) + y_{OLD}$$

$$Z_{NEW} = (z_{NEW} \times HEIGHT) + z_{OLD}$$

FIGURE 5-1. Example of Summary Subroutine Description.

5.0   TERMS AND ABBREVIATIONS.

A list of Terms and Abbreviations is in the MM. Applicable definitions from this list should be included in standard SPM, Section 5.0 along with any additional definitions that may be necessary.

APPENDIX A: DETAILED CALL HIERARCHY.

A detailed call hierarchy should be developed and included in the standard SPM.

Other Appendices. The discussion and diagram of the directory tree structure in Tab A of the URM, Part II should be moved to SPM, Appendix B.

5.2.3   Software Analyst's Manual

The purpose of the SAM is to describe the functional structure and algorithms of a model. It should describe the purpose and background of the model in general terms and give detailed technical descriptions of its complete capabilities, structure, and functions. These detailed descriptions should divide the capabilities of the model into the major functions it performs. All equations, algorithms, and decision processes used by each major function should be described in detail. Details also should be given about model assumptions, limitations, and flexibility (ability to address different types of problems). Inputs and outputs should be described in words, rather than file formats. Each module should be described in great detail to explain the correlation between the modules and model functional descriptions. The SAM enables the user to understand the theoretical basis of the model. The user needs it to facilitate understanding of the code and to ensure that the model is appropriate for particular analysis requirements.

5.2.3.1   Standards

The recommended format for a SAM is described in [9] and repeated below:

> **Title Page and Preliminary Information**. The SAM Title Page should include the following information: Model Names, Version Number, Volume Number (if applicable), Development Agency, Contract and CDRL Numbers (if applicable), Date Published, Distribution and Destruction Notices (if applicable), and Document Control Number (DCN). The contractor name and address should also be included on the Title Page, prefaced by the term "Prepared by." In addition to the Title Page, a Foreword (Abstract), Table of Contents, List of Tables, and List of Figures should be provided as well.
>
> **SECTION 1: INTRODUCTION**
>
> **1.1   Identification**. Identify the exact model title, its acronym or abbreviation, the version umber, and any other official model identification information.
>
> **1.2   System Overview**. State the purpose of the model. Include its mission, a general description of the physical systems simulated, and a general description of the intended scenarios. Discuss the types of problems addressed and types of answers provided by the model. Provide overviews of all major modes of operation and scenarios corresponding to each mode. Auxiliary programs used to generate input data or process output data should be acknowledged and described.
>
> **1.3   Document Overview**. List and describe the purpose of each section of the SAM. Also identify any other documents in the document set containing the SAM.
>
> **SECTION 2: REFERENCED DOCUMENTS**
>
> List the title, number, author, publisher, date, and classification level (unless all are unclassified) for each document used in generating the SAM and for all known documentation for this model. Include sources for all documents not available through normal government stocking activities.

SECTION 3: FUNCTIONAL DESCRIPTION

3.1   Overview

Describe the model's complete functionality without reference to implementation methodology. These descriptions should elaborate on the overall mission and major modes described above in System Overview (Section 1.2). Descriptions should be presented in the order in which detailed functional methodologies are described in the sections that follow.

3.2   General Modeling Approach

3.2.1 Assumptions and Limitations. Describe high-level assumptions and limitations of overall model functionality.

3.2.2 Overall Modeling Methodology. Explain how assumptions, limitations, and the processes involved influence the general modeling methodology.

3.3   Detailed Functional Implementation Methodology

Describe how the capabilities of the model are functionally implemented. Divide this section into subsections corresponding to the major functions performed by the model and provide the following information for each subsection:

a.   Equations and Algorithms. Provide detailed technical descriptions and purposes for use of specific empirical and analytic equations, numerical algorithms, and decision processes used by the function. Use flow diagrams to depict the implemented logic and use illustrations to depict geometrical considerations when applicable. Justify use of specific probability distributions. When trade-off studies for equation usage were performed, justify use of the chosen equation.

b.   Equations for Variables. Present and describe all equations (using mathematical notation) used for calculating variables that are significant in the implementation of the functional element. Indicate the code variable names that correspond with the variables described by these equations.

c.   Model Inputs and Outputs. Identify the relationship of model inputs to equations and algorithms. Relevant inputs and outputs to a particular function should be described in words without reference to code implementation details.

d.   Code Module Correlation with Functionality. Identify each module used to implement an area of functionality and describe the processes contained in that module. The description of each module should contain its purpose, a detailed technical explanation, and definition of variables. Correlate these processes with the model functional descriptions. Applicable library functions may simply be listed with a short description.

e.   Impact on Model Results. Describe the impact of the functionality on overall model results.

SECTION 4: NOTES

4.1   GLOSSARY OF TERMS

4.2   ABBREVIATIONS

Appendices. Appendices may be used for ease in document maintenance, examples, and illustrations to assist in understanding model capabilities, or for readability of the core text material. Examples of appendix contents are logic flow diagrams, sample user interface printouts, examples of post-processor use, former studies published using this model, and any classified appendices.

APPENDIX A: DETAILED ASSUMPTIONS AND LIMITATIONS

Appendix A is reserved for describing all model assumptions and limitations. These should be organized by major areas of functionality. This appendix is the same as Appendix A of the SUM.

5.2.3.2 Assessment

The information required for an EADSIM Version 4.01 SAM is contained in a document called the MM [4]. It is close to fulfilling all the requirements for a standard SAM. The topics included are described in adequate detail, although some topics have not been addressed. The following paragraphs contain comments regarding the SAM requirements described in Table 5-4.

Title Page and Preliminary Information. The Table of Contents, List of Figures, and List of Tables in the MM comply with the requirements of the standard SAM. However, the Title Page for the MM is lacking some of the information required in a standard SAM. Information pertaining to the Contractor Name and Address, Contract and CDRL Numbers (if applicable), Distribution and Destruction Notices (if applicable), and a Document Control Number (DCN) is missing and needs to be included on the Title Page of a standard SAM. The page after the Title Page contains the Contractor Name and Address along with some information redundant with the Title Page. This information should be moved to the Title Page and this page then deleted. In addition, no Foreword exists for the MM; therefore, one should be developed for inclusion in the standard SAM.

1.0 INTRODUCTION.

1.1 Identification. The first paragraph of the introduction in Section 1.0 of the MM contains model identification information that should be included in the standard SAM, Section 1.1. The last two paragraphs belong in the document overview of standard SAM, Section 1.3 and should not be included in this section.

1.2 System Overview. The purpose of EADSIM is discussed in Section 2.0 of the MM. This section includes general descriptions of the intended scenarios with the physical systems involved. These descriptions are made for each major area of functionality. This information should be included in standard SAM, Section 1.2. The types of problems addressed and types of answers provided are alluded to throughout the MM; however, they should be explicitly reviewed in this section as well. Finally, a high-level discussion of the off-line post-processing tools described in current SUM, Section 7.3 and in URM, Part II, Section 8.0 should be developed for standard SAM, Section 1.2.

1.3 Document Overview. The document overview is discussed in the third (last) paragraph of Section 1.0 of the MM. The second paragraph from Section 1.0 of the MM discusses the documentation set included with EADSIM. These paragraphs need to be separated from that section and modified as necessary for inclusion to standard SAM Section 1.3.

2.0 REFERENCED DOCUMENTS.

No referenced documents section is provided in this manual. Some references are listed at the end of Sections 5.6 and 6.10.2 of the MM with others scattered in text throughout the document.   These and other applicable references need to be consolidated in Section 2.0 of the standard SAM.

3.0   FUNCTIONAL DESCRIPTION.

3.1   Overview. This topic is covered in the discussion on model architecture in Section 3.0 of the MSA for Version 4.01. This information should be included in standard SAM, Section 3.1.

3.2.1   Assumptions and Limitations. Discussions on these topics are scattered throughout the MM. High-level assumptions and limitations for each major area of functionality should be included in standard SAM, Section 3.2.1.

3.2.2   Overall Modeling Methodology. A description of high-level modeling methodology is not in the current Document Set. Some of these topics are scattered throughout the MM. A section explaining how assumptions, limitations, and the processes involved influence the general modeling methodology should be generated for standard SAM, Section 3.2.2.

3.3   Detailed Functional Implementation Methodology.

    a.   Equations and Algorithms. Adequate descriptions of equations and algorithms are covered in Sections 4.0 through 10.0 of the MM. Some of these sections need to be updated with the new sections and appendices from the MSA. The discussion on Sensor Resource Management in Section 4.11 of the MSA is entirely new while the material on Captive Platforms in MM, Section 4.8 has been replaced by new material on Jamming Control in MM, Section 4.8 of the MSA. If the information on Captive Platforms is applicable, it should be in MM, Section 4.8 (or whatever section number replaces it in the new SAM) and the material on Jamming Control should be added to a new section at the end. All of this information should be included in standard SAM, Section 3.3.

    No empirical functions were found in the existing documentation. However, empirical data was found in the three Standard Atmosphere Data Tables in Section 5.6.7 of the MM. Two of these tables are referenced to their source documents for additional information. The third one (Table 5-1 of the MM) should also be referenced to its source document. Since no functions are included in this information, detailed descriptions are not necessary, unless empirical formulas have been developed to characterize the data.

    The input file variable "FluctRCSModel" has five options (SWERLING 0, I, II, III, and IV) available for probability of detection distributions in Tab D of the URM, Part II. However, only two types of probability distributions (SWERLING I and III) are described in Section 6.5.7 of the MM. Descriptions of the SWERLING 0, II, and IV cases need to be added to the other cases for inclusion into standard SAM, Section 3.3. Justification for use of these distributions has not been provided and should be developed for standard SAM, Section 3.3.

    b.   Equations for Variables. Adequate descriptions of the equations used to calculate variables for the main program equations and algorithms are provided in Sections 4.0 through 8.0 of the MM. These descriptions should be included in SAM, Section 3.3 as well as the equations and algorithms.

    c.   **Inputs and Outputs**. Descriptions of the run-time processes used by the program are included in MM Sections 4.0 through 7.0.   Each of these processes is divided into the main areas of functionality for that process. A generic description of the inputs to each of these processes is given. Inputs to and outputs returned from specific areas of functionality in these processes are not clearly defined although they can often be deduced through analysis of the equations in these areas. Additional equations are described in the Scenario Generation discussion in MM, Section 8.0. This section describes a GUI that is used to aid in the preparation of inputs to the model.   Inputs to and outputs returned from the different GUI functions are not clearly defined.   Tables detailing the relationship of inputs and outputs to each area of functionality listed in MM, Section 4.0 through 8.0 should be developed for inclusion in standard SAM, Section 3.3.

    d.   **Module Correlation with Functionality**. Discussions of the modules used to implement the areas of functionality described in Sections 4.0 through 10.0 of the MM do not exist. Identification of these modules and elaboration on their contents in adherence to the SAM standards, in Section 5.2.2.1, is recommended. These modules should be correlated to the areas of functionality they are used in.   The modules could be included with the tables of inputs and outputs recommended in the previous section. These discussions should be included with the content of MM, Sections 4.0 through 10.0 in standard SAM, Section 3.3

    e.   **Impact on Model Results**.   The effects that particular areas of functionality have on overall model results are discussed in adequate detail in current MM, Sections 4.0 through 10.0. The information in these sections should be included in standard SAM, Section 3.3.

4.0   TERMS AND ABBREVIATIONS.

Terms and Abbreviations are found prior to the Introduction of MM, Section 1.0. These should be in standard SAM, Section 4.0.

APPENDIX A: DETAILED ASSUMPTIONS AND LIMITATIONS.

Discussions on these topics are scattered throughout the MM. All assumptions and limitations for each area of functionality should be discussed in detail in Appendix A of the standard SAM (same as Appendix A in the standard SUM).

Other Appendices. MM Appendix B1 is just an introduction to the subsequent appendices and should not be in a separate appendix. This introduction should be modified to introduce, and should be inserted prior to, the appendices.   MM, Appendices B2 through B6 should be renamed as SAM, Appendices B through F, respectively.

5.3   RECOMMENDED MODIFICATIONS

The sections that follow summarize the changes needed to bring EADSIM Version 4.01 documentation into compliance with the recommended standards [9].   Table entries provide estimates of the number of additional pages needed to complete such recommendations.   Comments are also included in these tables regarding what

recommendations are being made. These estimates are rough order of magnitude (ROM) based on the current understanding of EADSIM and its documentation. Wherever possible, the page estimates are based on treatments of similar topics in the EADSIM documentation or in the documentation of other models.

5.3.1   EADSIM Software User's Manual

The current SUM is very close to fulfilling all the requirements for a standard SUM. Table 5-5 presents a summary of the recommendations from the above discussions to bring the SUM into compliance with documentation standards.

TABLE 5-5. Estimated Number of New Pages for EADSIM SUM.

Section/Topic	Number of New Pages	Recommendations
Title Page and Preliminary Information	0	Develop Foreword, modify Title Page, delete page after Title Page.
1.1 Identification	0	Copy first paragraph from current SUM Section 1.0.
1.2 System Overview	_	Copy from current SUM Section 2.0 and discuss off-line tools.
1.3 Document Overview	_	Mostly new and should be developed. Copy document set discussion from last two paragraphs of current SUM, Section 1.0 (reference ES).
2.0 Referenced Documents	2	All new and should be developed.
3.1 Initialization	0	Copy from current SUM, Sections 4.1 (except 4.1.7), 4.2, 4.3, and 6.1. Copy from Tab C of URM, Part II.
3.2 User Inputs	3	Copy from current SUM Section 5.0. Copy from Tab D of the URM, Part II and add definitions for input file variables.
3.3 Links to Other Programs	0	Copy from current SUM, Section 7.3. Copy from SUM, Section 8.0 of the MSA. Copy from Section 8.0 of the URM, Part II.
3.4 Outputs	0	Copy from current SUM, Sections 6.2, 6.3.2, 7.1, and 7.2.
4.0 Error Messages	20	Copy from current SUM, Sections 6.3.1, 6.3.3, and 6.3.4, and from MM, Section 8.6. Add detailed error message/action descriptions (most of this section will be new).
5.0 Terms and Abbreviations	0	Copy from beginning of current SAM.
Appendix A: Detailed Assumptions and Limitations	8	All new and should be developed.
Other Appendices	0	Copy the URM, Parts I and II (current SUM Section 3.0) to SUM Appendix B, Volumes I and II. Copy URM Tabs E and F to SUM Appendices, C and D. Copy current SUM, Section 4.5 to SUM, Appendix E.

More detailed information on the URM is as follows:

Rename the URM as Appendix B, except for Section 8.0 and Tabs A through F. Include URM, Section 8.0 in standard SUM Section 3.3. Do not include redundant information from this section. Tabs A and B should be copied to the SPM while Tabs C and D should be included in SUM, Sections 3.1 and 3.2, respectively. Finally, Tabs E and F should be renamed as SUM, Appendices C and D.

5.3.2   EADSIM Software Programmer's Manual

As mentioned before, a SPM was not provided with the EADSIM Document Set. Some of the requirements for a SPM are found in the current SUM, MM, and MSA. However, most of the SPM will have to be developed from scratch since much of the required information is missing. Table 5-6 presents a summary of the recommendations from the above discussions to bring the SPM into compliance with documentation standards.

TABLE 5-6. Estimated Number of New Pages for EADSIM SPM.

Section/Topic	Number of New Pages	Recommendations
Title Page and Preliminary Information	11	All new and should be developed for the SPM.
1.1 Identification	0	Copy first paragraph from MM, Section 1.0.
1.2 System Overview	_	Copy system overview from Section 2.0 of MM and discuss off-line tools.
1.3 Document Overview	_	Mostly new and should be developed. Copy Document Set discussion from second paragraph of MM, Section 1.0.
2.0 Referenced Documents	2	All new and should be developed.
3.1 Equipment Configuration	0	Copy from current SUM, Section 4.4.1. Copy pertinent information from RN, Sections 4.0 and 5.0 of the MSA, and from ES, Section 1.4.
3.2 Operational Information	0	Copy from current SUM Sections 4.4.2, 4.4.3, and 4.4.4. Copy from RN Section 2.8. Copy from ES, Section 1.4.
3.3 Compiling and Linking Instructions	0	Copy from current SUM, Section 4.1.7. Copy pertinent information from RN and Sections 4.0 and 5.0 of the MSA. Copy from Tab B of URM, Part II.
4.1 Introduction to Programming Information	1	Add section on coding conventions with short developmental history.
4.2 Call Hierarchy	3	Develop a high-level call hierarchy.
4.3 Dictionary of Variables	20	Develop a variable definition list.
4.4 Global Variables	30	Develop external variable definitions.
4.5 Program, Subroutine and Function Descriptions	N	Develop module (function) definitions (N = number of modules).
4.6 Error Detection and Diagnostic Features	n/2	Copy from MM, Section 8.6. Develop error condition and diagnostic table (n = number of diagnostics).

TABLE 5-6. Estimated Number of New Pages for EADSIM SPM.

Section/Topic	Number of New Pages	Recommendations
5.0 Terms and Abbreviations	0	Copy from beginning of MM V4.0.
Appendix A. Detailed Call Hierarchy	27	Develop a detailed call hierarchy.
Other Appendices	0	Copy Tab A of URM, Part II to SPM, Appendix B.

5.3.3   EADSIM Software Analyst's Manual

The EADSIM Version 4.01 MM is close to fulfilling all the requirements for a standard SAM. Table 5-7 presents a summary of the recommendations from the above discussions to create a standard SAM.

TABLE 5-7. Estimated Number of New Pages for EADSIM SAM.

Section/Topic	Number of New Pages	Recommendations
Title Page and Preliminary Information	0	Develop Foreword, modify Title Page, and delete page after Title Page.
1.1 Identification	0	Copy first paragraph from MM, Section 1.0.
1.2 System Overview	1	Copy from MM, Section 2.0 and discuss problems, answers, and off-line tools.
1.3 Document Overview	0	Copy last two paragraphs from MM, Section 1.0.
2.0 Referenced Documents	2	Mostly new. Copy some from end of MM Sections 5.6 and 6.10.2. Others are scattered throughout MM text.
3.1 Functional Description Overview	0	Copy from Section 3.0 of MM Version 4.01 in MSA.
3.2.1 Assumptions and Limitations	2	Mostly new. Some can be copied from scattered sections of MM. Describe high-level assumptions and limitations.
3.2.2 Overall Modeling Methodology	10	All new.
3.3 Detailed Functional Implementation Methodology		
a. Equations and Algorithms	$1 + X$	Copy from MM, Sections 4.0 through 10.0. Copy updated and new sections from MM part of MSA. Discuss additional Swerling cases for P_d distributions in MM, Section 6.5.7 and justify use of all distributions (X = # of undescribed algorithms).
b. Equations for Variables	0	Copy from Sections 4.0 through 8.0 of the MM.
c. Inputs and Outputs	$Y/2$	Copy from Sections 4.0 through 8.0 of the MM. Develop table of inputs and outputs for each area of functionality (Y = # of functional elements).
d. Module Correlation with Functionality	$Y/2$	All new. Develop list of modules, including contents, used by each functional element (Y = # of functional elements).
e. Impact on Model Results	0	Copy from Sections 4.0 through 8.0 of the MM.
4.0 Abbreviations and Terms	0	Copy from list of Terms and Abbreviations at the beginning of the MM.
Appendix A: Detailed Assumptions and Limitations	8	Mostly new. Copy some from scattered MM sections. Describe all assumptions and limitations in detail.
Other Appendices	0	Use MM, Appendix B1 to introduce Appendices. Modify and insert prior to Appendix A, but not in separate appendix. Rename MM, Appendices B2 through B6 as SAM, Appendices B through F, respectively.

5.3.4   Summary

A significant level of effort will be required to generate three standard manuals as described in Section 5.2. Table 5-8 summarizes the estimated number of new pages required for each manual, which could include information from several separate sources.

TABLE 5-8. Summary: Estimated Number of New Pages.

Manual	Additional Pages
SUM	34
SPM	$95 + N + n/2$
SAM	$24 + X + Y$
Total	$153 + N + n/2 + X + Y$

Notes:
  N = # of modules in EADSIM
  n = # of error diagnostics
  X = # of undescribed algorithms
  Y = # of functional elements

The documentation for EADSIM will require much work to fulfill the recommended standards. The missing information will require a fairly large number of new pages. The bulk of the new pages will contain program module (function), module variable, and global variable descriptions to create a standard SPM. These are not as technically demanding as the theoretical discussions in a SAM; although, time to examine the code and write the descriptions will be required. The rest of the new pages will largely consist of detailed descriptions of error messages and diagnostics.

Model documentation is worth a significant expenditure of resources. The Military Operations Research Society (MORS) has included good documentation as an important step in the model validation process [10]. A complete set of standard manuals will allow a prospective user to evaluate EADSIM for applicability to a particular analysis requirement. The documents will facilitate ease of model use and will help model credibility by enhancing user confidence.

5.4   IMPLICATIONS FOR V&V

The quality of the EADSIM Version 4.01 documentation was found to be fair. The Methodology Manual [5] explicitly describes algorithms along with equations and a few references. The User's Manual [2] identifies and describes all input data required. The User's Reference Manual, Parts I & II [3 and 4] details each option of the program as presented to the user. The Manual Set Addendum [6] describes changes in the program for Version 4.01.

No detailed list was found of model errors and corrective actions for the user to take. No descriptions were found of high-level assumptions and limitations for the simulation model. The most serious deficiency, however, is the lack of a SPM which is important for verification and validation activity. Program module, global variable, coding convention, and module variable descriptions are missing from the current documentation which could

impede efforts to assess functionality of individual modules. Some of the information normally contained in the SPM can be found in the SUM and MM, but the bulk of the required documentation for the SPM is not in the Document Set.

The lack of an adequate list of referenced documents could also hinder V&V efforts. For example, verification of an algorithm against an authoritative reference may not be possible within limited resources without the cited reference. When previously missing information is incorporated into one of the manuals, its reference documentation needs to be included in Section 2.0 of that manual.

5.5   IMPLICATIONS FOR MODEL USE

EADSIM documentation is generally complete, except for SPM-related material. Deficiencies noted in this manual, particularly the lack of global variable and module variable descriptions, can be compensated for by a review of the code.

The lack of adequate model execution error diagnostics in the SUM and the SPM could hinder the timely correction of problems. In addition, the absence of a discussion on assumptions and limitations could lead to improper program setup and erroneous interpretation of output data. The development of document overviews and the improved definition of the input file variables would reduce new-user training efforts.